PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G08B 13/24, G01S 13/74, G06K 7/10, 7/08

A1

(11) International Publication Number: WO 94/19781

(43) International Publication Date: 1 September 1994 (01.09.94)

(21) International Application Number: PCT/NL94/00038

(22) International Filing Date: 16 February 1994 (16.02.94)

(30) Priority Data:
9300290 16 February 1993 (16.02.93) NL

(71) Applicant (*for all designated States except US*): N.V. NEDERLANDSCHE APPARATENFABRIEK NEDAP [NL/NL]; Oude Winterswijkseweg 7, NL-7141 DE Groenlo (NL).

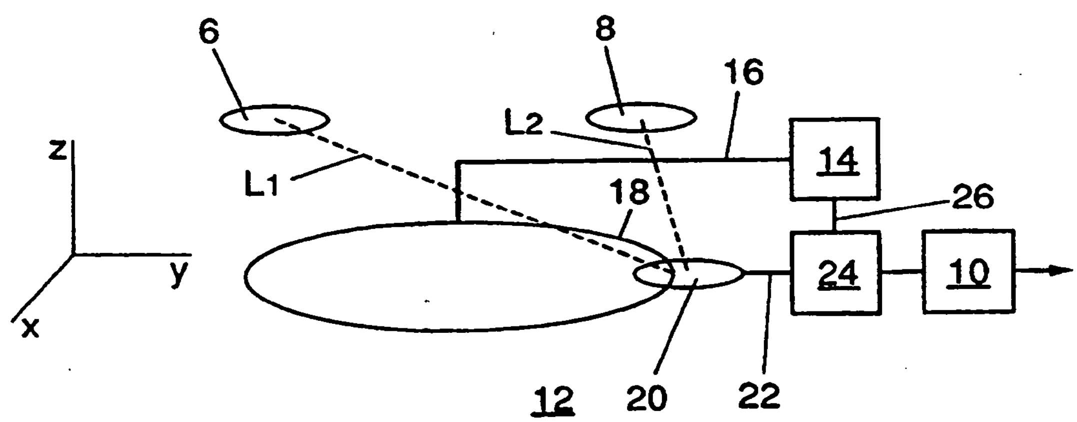
(72) Inventor; and
(75) Inventor/Applicant (*for US only*): KIP, Harm, Jacob [NL/NL]; Lariksstraat 4, NL-7132 CS Lichtenvoorde (NL).

(74) Agent: SMULDERS, Th., A., H., J.,; Vereenigde Octrooibureaux, Nieuwe Parklaan 97, NL-2587 BN The Hague (NL).

(81) Designated States: US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
In English translation (filed in Dutch).

(54) Title: IDENTIFICATION SYSTEM FOR READING OUT A PLURALITY OF TRANSPONDERS IN AN INTERROGATION FIELD AND DETERMINING THE POSITION OF THESE TRANSPONDERS



(57) Abstract

The invention relates to a detection system for identifying an electronic transponder, the system comprising a transmitter unit and at least one transmitting antenna coupled thereto for generating an electromagnetic interrogation field. The system further comprises a detection unit for detecting signals emitted by the transponders when they are located in the interrogation field. In accordance with the invention, the detection unit comprises means for detecting signals coming from different transponders on the basis of strength differences between these signals.

Title: Identification system for reading out a plurality of transponders in an interrogation field and determining the position of these transponders.

The invention relates to a detection system for identifying an electronic transponder, the system comprising a transmitter unit and at least one transmitting antenna coupled thereto for generating an electromagnetic interrogation field and a detection unit for detecting signals emitted by the transponders when they are located in the interrogation field.

Such a system is for instance disclosed in U.S. Patent 4,459,474. This system may comprise two receiving antennas which enable the movement of a transponder to be determined. In addition, the system may comprise means for separating from each other transponder signals which are emitted by different transponders and are emitted at least temporarily simultaneously, on the basis of phase relations between the bit data of these transponder signals. In practice, this proves to be a costly method.

The object of the invention is to provide a system which makes it possible in a simple manner for simultaneously emitted transponder signals to be distinguishably detected. More specifically, the object of the invention is to provide a system whereby moreover the position of a transponder can be determined.

In accordance with the invention, the detection unit to this end comprises means for detecting the transponder signals coming from different transponders on the basis of strength differences between these signals. The invention is based on the insight that different transponder signals can often be received with a different strength. In accordance with a particular embodiment, the detection unit comprises at least one receiver unit having at least one small receiving antenna coupled thereto, the receiving antenna having such a small size that strength differences arise

between received transponder signals coming from different transponders.

In wireless and batteryless identification systems, such as described, for instance, in Dutch Patent 176404, European patent application 0,030,127 and international patent application WO90/14736, only the strongest transponder is detected when several transponders are active within the interrogation field. If several transponders cause signals that differ relatively little in the receiver, the receiver will not detect any signal at all. This effect can occur in particular with systems where the detection distance is large. This may present problems in applications where it is not always possible to spatially separate the transponders sufficiently. For instance in systems for selectively providing access to ski-lifts by means of transponders it is often impossible, as a result of the jostling, to avoid situations where several transponders enter the range of one and the same reader unit.

To yet enable detection of several transponders simultaneously located within the range of the interrogator device, different solutions are known.

For instance, European patent specification 0,285,419 discloses a system where entire search trees are traversed to select one of the transponders present. After a first transponder has been selected, a next transponder is selected, and so forth, until all transponders have been selected. A drawback of this method is that, on the one hand, the transponders become very complicated and, on the other, the readout time becomes very long.

The same disadvantages are inherent in the solution according to U.S. Patent 5,124,699, where, after it has been established that several transponders are active simultaneously, a selection is made by way of a random wait time.

Another known solution provides a transponder incorporating an arbitrary interval after it has transmitted a code. During

this interval the transponder does not transmit any codes. Because of the arbitrary nature of the intervals, whose duration is preferably between, for instance, 3 and 10 times the period for emitting a code, occasionally a situation will arise where only one of the transponders present is active. This transponder can then be simply detected. A disadvantage of this system is that on average it takes very long for a transponder to be identified on the basis of the emitted code. This disadvantage does not outweigh the advantage that such a system can be realized relatively easily.

In a system according to European patent application 0,161,779 it is attempted, upon simultaneous reception from several transponders, to selectively switch off one active transponder at a time. This also presents the disadvantage that the average time for a transponder to be detected increases in comparison with conventional systems and moreover renders the system complex.

The invention, however, provides a solution for the detection of several transponders within a single interrogation field, without the transponders becoming more complex and without additional time being required for the detection of several responders.

Another problem encountered with identification systems of ski-lifts, for instance, is that it is not always clear that the skier who is the next to be admitted is in fact the person whose transponder is being read.

The invention, however, enables determination of the relative position of transponders as well. To that end, a particular embodiment of the identification system according to the invention is characterized in that the detection unit further comprises a data processing unit for processing received signals obtained by means of a receiver unit and that the data processing unit processes the strengths of the received transponder signals

in combination for determining a position and/or rotative orientation of a transponder.

It is generally known that the signal strength of the received signal is related to the distance between the transponder and the antenna.

German Offenlegungsschrift 3,714,263 describes a localizing system whereby locally a large field gradient is created by controlling two transmitting coils in opposite phase. The sharp mimimum of the field strength equals zero, so that at a well-defined point the transponder momentarily stops generating a code. It is clear that this is not a good method of identifying and localizing several transponders simultaneously.

Another and more accurate solution to the localizing problem is disclosed in European patent application 0,257,688, where a separate pilot tone is generated in the transponder, whereafter by means of 8-shaped receiving antennas the position of the transponder is determined from the strength of the pilot tone. This highly accurate method requires special provisions on the transponder and is therefore more complicated than the solution according to the invention.

An additional problem with the above localizing methods is that the orientation of the transponder affects the outcome of the determination of the position, which may cause errors if the transponders are freely movable.

In accordance with the invention, however, the orientation of the transponder can be determined as well, though often with a limited accuracy. The solution according to the invention is sufficiently accurate to solve the above-mentioned sequence problem such as may occur, for instance, in access control with ski-lifts.

The invention starts from the assumption that there are clearly measurable strength differences between the signals being received. This means that the number of transponders that can be read out simultaneously is limited.

In practical applications this is not a limitation; because of the physical dimensions of those carrying the transponders, rarely more than, for instance, three transponders can be present within the range of the transmitter and receiver units.

The invention will be further elucidated with reference to the drawing. In the drawing:

Fig. 1 shows a known identification system;

Fig. 2 shows a first embodiment of an identification system according to the invention;

Fig. 3 shows a second embodiment of an identification system according to the invention; and

Fig. 4 shows a third embodiment according to the invention.

In Fig. 1 reference numeral 1 denotes a known identification system. The detection system 1 comprises a large antenna 2 which is coupled to a transceiver unit 4. By means of the transceiver unit 4, by way of the antenna 2 an interrogation field is emitted in which in this case a first and a second transponder 6, 8 are located. The transponders 6, 8 are of a generally known type which emits a signal when it is introduced into the interrogation field. Hereinafter it is assumed that the transponder draws energy for its operation from the interrogation field. However, it is also possible for the transponder to comprise, for instance, a battery.

The signal emitted by a transponder comprises a code associated with this transponder, by which a transponder can be identified.

A transponder signal emitted by a transponder 6, 8 is received by the transceiver unit 4 by way of the antenna 2. The received signals are subsequently transmitted to a data processing unit 10 for further processing the received signals. The data processing unit is *inter alia* adapted for identifying transponder codes present in the received signals.

Although the two transponders 6, 8, which are located above antenna 2, are spatially far apart from each other, they yet have

substantially the same distance L1, L2 to the antenna 2. As a consequence, the strength, i.e. the amplitude, of the signals caused in the antenna 2 by the two transponders 6, 8 will be little different. As a result, neither of the transponders can be identified by the receiver unit 4 and the data processing unit 10.

At the large antenna 2 a large quantity of signal is received. However, there are a large number of possible transponder positions and orientations that generate one and the same signal strength in the large receiving antenna coil. Because of the large coil, an integration over a large surface occurs. The result is that the known receiver unit and the data processing unit 10 will not detect any signal at all and will not identify either of the transponders 4, 6. This problem occurs both with systems that operate according to the principle of absorption and with systems that operate according to the principle of transmission.

In Fig. 2 the reference numeral 12 denotes a first embodiment of an identification system according to the invention, which meets the above objections. Parts corresponding with Fig. 1 have been provided with the same reference numerals. The system 12 comprises a transmitter unit 14 and a transmitting antenna 18 connected therewith through line 16. By means of the transmitter unit 14, by way of the antenna 18 an interrogation field is emitted in which in this case the transponders 6, 8 are located. The system 12 further comprises a small receiving antenna 20 and a receiver unit 24 connected therewith through line 22. A signal received and demodulated by the receiver unit 24 is supplied to a data processing unit 10 of a type as described with reference to Fig. 1. The transmitter unit 14, antenna 18, receiver unit 24 and the data processing unit 10 are all of a generally known type.

Because the distance L1 between the first transponder 6 and the antenna 20 is greater than the distance L2 between the second

transponder 8 and the antenna 20, the strength of the received signal coming from the first transponder 6 will be much less than the strength of the received signal coming from the second transponder 8.

In accordance with a first aspect of the invention, this fact is used to distinguish from each other the received transponder signals coming from different transponders. Because the signal coming from the second transponder is much greater than the signal coming from the first transponder, the signal coming from the second transponder can be straightforwardly detected. This is a major advance compared with the system according to Fig. 1, because in the latter system neither transponder could be detected. Because of the small antenna 20, however, less signal is received than with the antenna 2, but also fewer interference signals, so that yet a good signal-to-noise ratio can be realized with very small, in an extreme case almost point-shaped, receiving antennas.

If a transponder comprises a series resonance circuit, so that the transponder can draw its energy from the interrogation field, the distance between the transponder and the transmitting antenna 18 also affects the magnitude of the amplitude, i.e. the strength of the received transponder signal. In that case the frequency of the signal emitted by a transponder will often depend on the frequency of the interrogation field. This means that the receiver unit 24 can be tuned to a receiving frequency band which is dependent on the interrogation field emitted by the transmitter unit 14. To that end, preferably in known manner a signal representing the frequency or frequencies of the interrogation field is supplied to the receiver unit 24 through line 26.

Naturally, the own noise contribution of a signal amplifier of the receiver unit 24 is of importance. In the case of a small antenna 20 there is in most cases a substantial difference in the distance between transponders located in different positions and

the small antenna 20. Because the strength of the received signal is affected not only by the distance to the receiving antenna but also by the rotative position of a transponder 6, 8, it may still happen that the strength differences of the transponder signals are still too slight for proper detection.

Fig. 3 shows a particular embodiment of a system 28 according to the invention, which meets the last-mentioned drawbacks. Parts corresponding with Fig. 2 have been provided with the same reference numerals. The system 28 comprises a second small receiving antenna 30 which is connected with a second receiver unit 34 through line 32. The signals received by the second receiver unit 34 are also supplied to a data processing unit 10. In this case both the signals received by the first receiver unit and the signals received by the second receiver unit are supplied to one and the same data processing unit 10. However, this is not essential to the invention. As appears clearly from Fig. 3, the distance L3 between the first transponder 6 and the second receiving antenna 20 is smaller than the distance between the second transponder 8 and the second receiving antenna 30. This means that the first transponder 6 will generate the strongest signal in the second receiving antenna 30, while the second transponder 8 will generate the strongest signal in the first receiving antenna 20. Accordingly, the first receiving unit can detect the second transponder, while the second receiver unit can detect the first transponder. The signals thus received are supplied to the data processor 10 for identifying the codes emitted by the transponders.

More generally, it can be said that the addition of the second receiving antenna 30, which is far removed from the first receiving antenna 20, renders it very unlikely that this receiving antenna, too, will see too slight strength differences. This means that the second receiving antenna increases the chances that in any case one of the two transponders in this example is identified and that possibly even two transponders can

be identified simultaneously. In general, it can be said that the addition of small receiving antennas to a detection system according to the invention increases the probability of being identified for every transponder. Moreover, in a dynamic environment the position of transponders changes constantly. A third or even fourth receiving antenna coil creates a situation where nearly always at least one receiving antenna receives such a strength difference as to enable detection of the strongest signal of any transponder. Receiving a strongest signal by means of one receiving antenna and one receiver unit is essentially nothing other than what is done with the existing technique in one receiver unit with one (large) antenna.

The small receiving antennas according to the invention create in at least substantially every receiver unit a greater difference in signal strength between the received signals coming from different transponders.

A simple system for detecting several transponders could, entirely analogously to Fig. 3, consist of more than two small receiving antennas with associated receiver units. Because the small antennas maximize the differences in distance between transponders and receiving antenna, there is a good chance that in a receiver unit a sufficient difference in the strength of signals coming from different transponders will occur for the transponders to be detected.

Fig. 4 diagrammatically shows an identification system with n receiving antenna 20.i and n receiver units 24.i, with n and i being integers greater than or equal to 1, and $0<i<n+1$. If n is great while a plurality of transponders are located in the interrogation field, there is a good chance that the signal emitted by an arbitrary transponder is received as the strongest signal in at least one receiving antenna.

The receiving antennas 20, 30, 20.i, described with reference to Figs. 2-4, are qualified as small. This is meant to say that the receiving antennas are so small that strength

differences between signals coming from different transponders are enlarged.

In accordance with a possible embodiment the dimensions of the receiving antenna are small relative to the maximum distance at which a transponder located in an interrogation field can be detected. In accordance with a possible embodiment, the dimensions of the receiving antenna are small relative to a cross section of the area in which a transponder can be detected. The magnitude of this detection area depends *inter alia* on the power of the transmitter unit 14, the frequency of the interrogation field generated by the transmitter unit 14 and the geometry of the transmitting antenna 18. In accordance with another embodiment, dimensions of the receiving antenna are small relative to the dimensions of the transmitting antenna 18. By 'small relative to' is meant, for instance, smaller by at least a factor of four. Preferably, however, smaller by at least a factor of 10 is meant. In particular, smaller by at least a factor of 50 is meant. In accordance with a highly advantageous embodiment, however, smaller by at least a factor of 100 is meant.

In accordance with a particular embodiment, the receiving antennas have a size comparable with the size of a transponder. More specifically, a transponder comprises a transmitting and receiving antenna coil with dimensions of the same order of magnitude as the dimensions of a receiving antenna. Preferably, a receiving antenna and/or a transmitting antenna 18 also consist of a coil.

The size of a coil can in this connection be defined, for instance, as a cross section of the surface enclosed by a winding of a coil or the square root of the area of that surface.

In accordance with a very particular embodiment, windings of a coil of a receiving antenna enclose a surface whose magnitude is approximately equal to the surface enclosed by a winding of a coil of a transponder.

In accordance with a highly advantageous embodiment, the dimensions of the receiving antenna are much smaller than the dimensions of the transponders. The transponders are often designed in the form of a credit card. The dimensions of the credit card may then be defined, for instance, as the magnitude of the flat surface of the card or the square root thereof.

An improved solution of the system according to Fig. 2, 3 or 4 is based on the assumption that, as soon as a strong signal has been detected in a receiver unit, the contribution of this signal to the overall received signal can be eliminated, whereafter the weaker signal emerges, so that two transponder codes can be detected virtually simultaneously.

Such elimination is not easy but can be carried out with known techniques. It is true that after detection the original code signal is known completely but on the way from a transponder to the receiver unit the code signals are deformed. This deformation manifests itself especially in the rounding off of the flanks. The deformation is dependent *inter alia* on the signal strength. On the basis of these data a best possible reconstruction of the contribution of the strongest responder signal to the overall signal received by means of a receiver unit 4, 24, 34, 24.i can be determined and subtracted from it. The correlation between the two signals must be minimized. In this way the artefacts remain small and a weaker transponder signal can appear above it. This signal is subsequently treated as the first strong signal, and so forth. As soon as it has been detected, it can be attempted to find a third signal.

The signal on a receiving antenna 20, 20.i, 30 is often present with a different strength on another receiving antenna as well. It is therefore also a part of the invention to examine, as soon as a code signal has been detected, whether there is a correlation between this signal and the various other signals received by means of the other receiving antennas. Such a correlation can be carried out by the data processing unit 10.

Minimizing the correlation makes it easier for the other transponder codes to be detected from the residual signals. Preferably, the large transmitting antenna 18 is also used as a receiving antenna for this purpose. Signals received by means of the large antenna 18 can then be correlated with the signals received by means of the small receiving antennas 20, 20.i, 30 (not shown in Fig. 2, 3 or 4).

A further improvement of the system is to arrange the receiving antennas on opposite sides of a passage to be guarded. Especially transponders which are located far away from all the receiving antennas arranged on one side of the passage can then be properly detected by the receiving antennas located on the other side of the passage. The code and the strength of each transponder signal such as it enters each receiving antenna can then be determined in accordance with the invention.

The strength of the signal gives a set of points where a transponder may be located. In fact, the strength of the received signal is determined by:

- the component of the field strength at the location of the responder, which is perpendicular to the plane of the transponder antenna;
- the conversion efficiency of the transponder;
- the distance between the transponder and the receiving antenna;
- the angle between the plane of the transponder and the connecting line from the transponder to the receiving antenna;
- the angle between the plane of the receiving antenna and the connecting line from the transponder to the receiving antenna.

Each receiving antenna gives a different set of points where the transponder may be located. Such a set can be expressed in an equation with five unknowns, these unknowns always being three position-dependent coordinates (for instance x, y, z) and two rotation-dependent coordinates, which represent the rotative orientation of the transponder. The starting-point is the

practical case where the transponder - more precisely, the antenna coil of the transponder - has an axis of symmetry, so that its rotative position can be expressed by means of two angular coordinates.

In principle five (n = 5) receiving antennas are sufficient to determine the position and orientation of a transponder, since each receiving antenna provides an equation with five unknowns. However, the accuracy of the system can be considerably improved when it comprises more than five receiving antennas (n > 5). On account of the high degree of non-linearity in the relations the analytic solution of the many equations with many unknowns is very complex.

A numerical solving method whereby a coarse grid of possible points where a transponder may be located is coupled to a limited number of rotative positions of the transponder provides for each antenna a limited number of possibilities for the orientation and position of the transponder. Each receiver provides such a set of possible transponder positions. The intersection of these sets then provides the actual position of the transponders. Precisely because of the complex relations that exist between the signal strengths and the position of the transponders does a solving method utilizing neural networks lead rapidly to useful results and especially the self-learning character of this solution is a particularly great advantage.

The inspiration for artificial neural networks is to be found in nature. The structure is like a highly simplified neuron. Hence the name. As to structure, a neural network consists of a plurality of neurons, which are interconnected in a layered structure. A neuron itself consists of a plurality of inputs with an adjustable amplification factor, followed by an adder and a limiter.

In the layered structure the output of a neuron is connected to the inputs of the neurons of the next layer. The purpose is to give the adjustable amplification factors a value such that the

network starts to display a desired behavior. Only in the past years have learning algorithms been developed to realize this. One of the most widely used learning rules is the so-called back propagation method, whereby a known pattern is presented to the input of the network. The actual value of the output is compared with the desired value and in the case of a difference between them the amplification factors are corrected in accordance with an algorithm. This is repeated with many learning examples until the network displays the desired behavior for the entire learning set. The neural network has now been taught and can then independently calculate an output on the basis of input values. Because of the self-learning ability of a neural network it is interesting to use such a network at points where either a complicated or an unclear algorithm is necessary.

The signal strength which a transponder causes in a receiving antenna (20, 20.i, 30) can be calculated from the Laplace formula. On the axis of a transponder this can be solved analytically, however, this becomes very complicated through rotation of the transponder. The inverse operation, i.e. calculating the possible position of a transponder from the signal strength, is particularly complicated to calculate analytically. Moreover, in a practical situation there are large differences from the idealized models. In short, there are two reasons that make it interesting to use a known self-learning neural network in a detection system according to the invention.

CLAIMS

1. A detection system for identifying an electronic transponder, the system comprising a transmitter unit and at least one transmitting antenna coupled thereto for generating an electromagnetic interrogation field and a detection unit for detecting signals emitted by the transponders when these are located in the interrogation field, characterized in that the detection unit comprises means for detecting the transponder signals coming from different transponders on the basis of strength differences between these signals.

2. A detection system according to claim 1, characterized in that the detection unit comprises at least one receiver unit having at least one small receiving antenna coupled thereto, the receiving antenna having a size so small that strength differences arise between received transponder signals coming from different transponders.

3. A detection system according to claim 2, characterized in that the dimensions of the receiving antenna are small with respect to the maximum distance at which a transponder located in an interrogation field can be detected.

4. A detection system according to claim 3, characterized in that the dimensions of the receiving antenna are small with respect to a cross section of the area in which a transponder can be detected.

5. A detection system according to any one of the preceding claims 2-4, characterized in that the dimensions of the receiving antenna are small with respect to the dimensions of the transmitting antenna.

6. A detection system according to any one of the preceding claims 2-5, characterized in that the dimensions of the receiving antenna are at least a factor of four smaller than the dimensions of the transmitting antenna.

7. A detection system according to any one of the preceding claims 2-5, characterized in that the dimensions of the receiving antenna are at least a factor of ten smaller than the dimensions of the transmitting antenna.

8. A detection system according to any one of the preceding claims 2-5, characterized in that the dimensions of the receiving antenna are at least a factor of 50 or 100 smaller than the dimensions of the transmitting antenna.

9. A detection system according to any one of the preceding claims 2-8, characterized in that the receiving antenna is approximately as large as the antenna of a transponder.

10. A detection system according to any one of the preceding claims 2-9, characterized in that the system comprises at least two spatially separated receiving antennas for enlarging said strength differences.

11. A detection system according to any one of the preceding claims 2-10, characterized in that the detection unit further comprises a data processing unit for processing received signals obtained by means of a receiver unit.

12. A detection system according to any one of the preceding claims 2-11, characterized in that the detection unit determines the strongest transponder signal from a received signal, at least substantially eliminates the contribution of the strongest

transponder signal from the received signal in order to obtain a residual signal and, if present, determines from the residual signal a second transponder signal which is weaker than the strongest transponder signal.

13. A detection system according to claim 12, characterized in that the strongest transponder signal is eliminated from the received signal by minimizing the correlation between the received signal and the strength signal.

14. A detection system according to any one of the preceding claims 11-13, characterized in that the system comprises at least two receiver units, the received signals generated by the receiver units being processed in combination by the data processing unit so as to determine said transponder signals.

15. A detection system according to any one of the preceding claims 10-14, characterized in that the data processing unit processes the strengths of the received transponder signals in combination in order to determine a position and/or rotative orientation of a transponder.

16. A detection system according to claim 15, characterized in that the data processing unit comprises a neural network for determining said position and/or rotative orientation of a transponder.

17. A detection system according to any one of the preceding claims 2-16, characterized in that at least one small receiving antenna is arranged in partial overlap with the transmitting antenna.

18. A detection system according to any one of the preceding claims 2-17, characterized in that receiving antennas are arranged on opposite sides of a passage.

19. A detection system according to any one of the preceding claims 10-18, characterized in that a transponder emits a transponder signal with a code associated with the relevant transponder and the data processing unit determines said code from a received signal.

20. A detection system according to any one of the preceding claims 2-19, characterized in that the transmitting antenna, receiving antenna and/or an antenna of a transponder comprise a coil antenna.

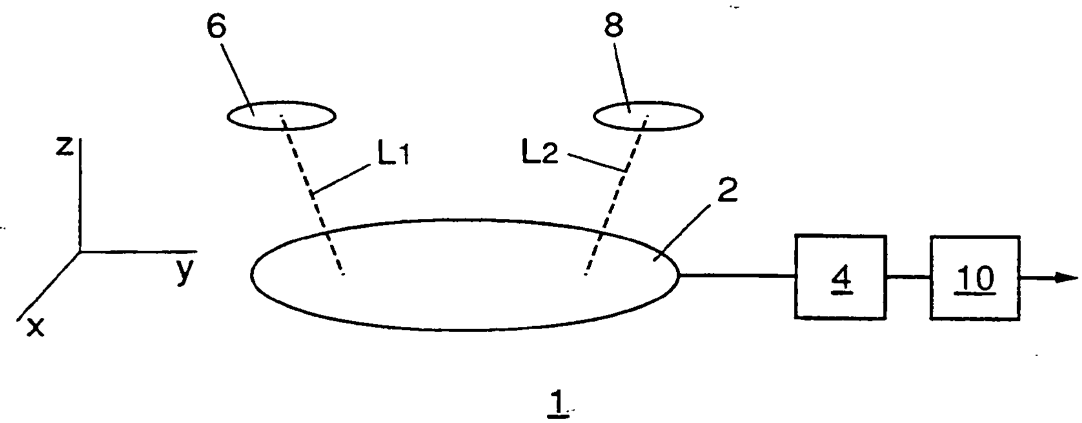


FIG. 1

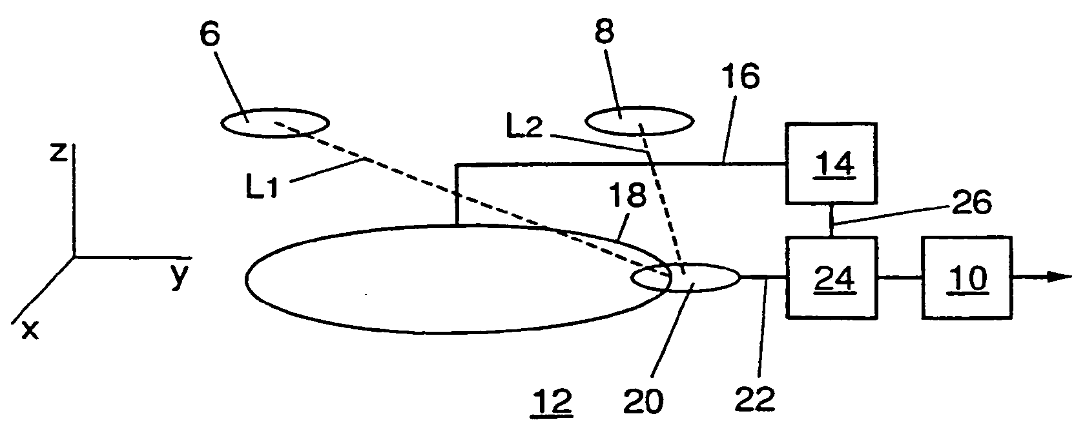


FIG. 2

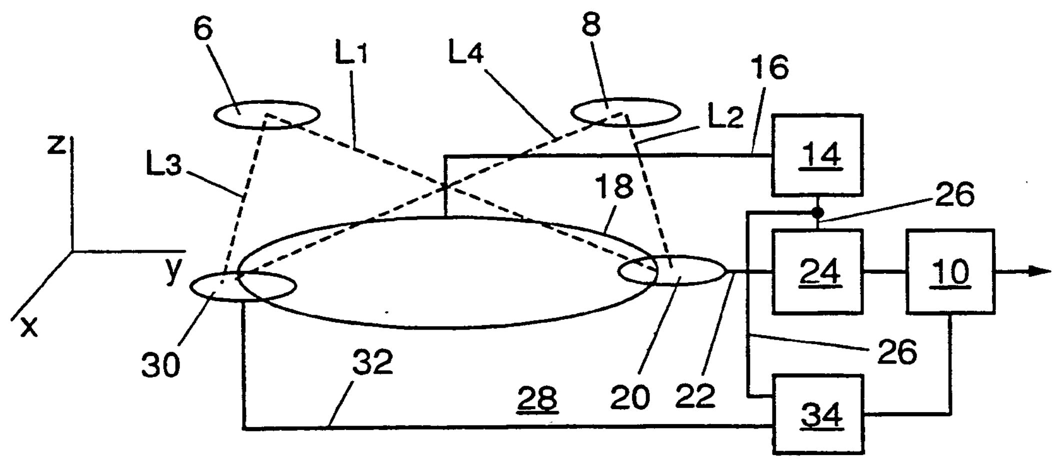

6
L1
L4
8
16
L2
14
z
L3
18
26
y
24
10
x
30
26
32
28
20
22
34

FIG. 3

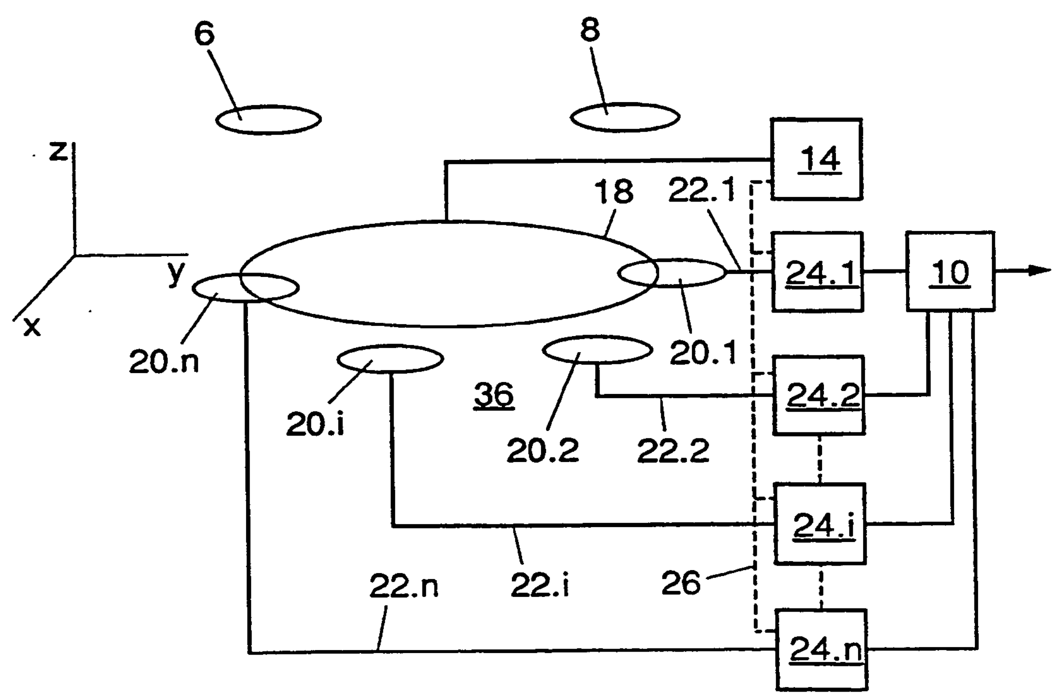

6
8
z
14
18
22.1
y
24.1
10
x
20.n
20.1
20.i
36
24.2
20.2
22.2
24.i
22.n
22.i
26
24.n

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL 94/00038

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 G08B13/24 G01S13/74 G06K7/10 G06K7/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 G08B G01S G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 459 474 (WALTON,C.A.) 10 July 1984 cited in the application see column 9, line 50 - line 52 see column 11, line 3 - line 6 see claim 2	1
A		10,12, 14,15

A	FR,A,2 544 867 (INTELLI-TECH CORP.) 26 October 1984 see page 5, line 30 - line 32 see page 11, line 7 - line 13 see page 18, line 24 - line 28 see page 32, line 35 see page 33, line 1 - line 3 see page 36, line 3 - line 8 see claims 5,7	1

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 June 1994	01. 07. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Herskovic, M

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,A,37 14 263 (GÖTTING JUN.,H.H.) 20 October 1988 cited in the application see the whole document ---	2
A	WO,A,92 22040 (COMMISSARIAT A L'ENERGIE ATOMIQUE) 10 December 1992 see claim 9 ---	15
A	WO,A,89 06367 (KORN,L.D. ET AL) 13 July 1989 see page 2, line 21 - line 31 see claims 6,8 -----	1,2,13

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/NL 94/00038

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4459474	10-07-84	NONE		
FR-A-2544867	26-10-84	US-A-	4656463	07-04-87
		CA-A-	1249359	24-01-89
		GB-A,B	2141006	05-12-84
		JP-A-	60100294	04-06-85
		US-A-	4827395	02-05-89
DE-A-3714263	20-10-88	NONE		
WO-A-9222040	10-12-92	FR-A-	2677135	04-12-92
		EP-A-	0586492	16-03-94
WO-A-8906367	13-07-89	AU-A-	3031289	01-08-89